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BD|SENSORS pressure measurement

Operating Manual CE

Electronic Pressure Switch DS 4XX

DS 400, DS 400 P, DS 401, DS 401 P

DS 400

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1. General information

1.1 Information on the operating manual

This operating manual contains important information on proper usage of the device. Read this operating manual carefully before installing and starting up the pressure measuring device.

Adhere to the safety notes and operating instructions which are given in the operating manual. Additionally applicable regulations regarding occupational safety, accident prevention as well as national installation standards and engineering rules must be complied with!

This operating manual is part of the device, must be kept nearest its location, always accessible to all employees.

This operating manual is copyrighted. The contents of this operating manual reflect the version available at the time of printing. It has been issued to our best knowledge. However, errors may have occurred. BD SENSORS is not liable for any incorrect statements and their effects.

– Technical modifications reserved –

1.2 Symbols used

⚠ DANGER! – dangerous situation, which may result in death or serious injuries

⚠ WARNING! – potentially dangerous situation, which may result in death or serious injuries

⚠ CAUTION! – potentially dangerous situation, which may result in minor injuries

! CAUTION! – potentially dangerous situation, which may result in physical damage

☞ NOTE – tips and information to ensure a failure-free operation

1.3 Target group

⚠ WARNING! To avoid operator hazards and damages of the device, the following instructions have to be worked out by qualified technical personnel.

1.4 Limitation of liability

By non-observance of the operating manual, inappropriate use, modification or damage, no liability is assumed and warranty claims will be excluded.

1.5 Intended use

- The **electronic pressure switch DS 4XX** has been developed, according to the type for applications, for absolute, vacuum and overpressure measurement. It is equipped with a 4-digit LED-display to show the current system pressure. Depending on the device and the mechanical connection it is suitable for various areas of use.
- It is the operator's responsibility to check and verify the suitability of the device for the intended application. If any doubts remain, please contact our sales department in order to ensure proper usage. BD SENSORS is not liable for any incorrect selections and their effects!
- Permissible media are gases or liquids, specified in the data sheet. In addition it has to be ensured, that this medium is compatible with the media wetted parts.
- The technical data listed in the current data sheet are engaging and must be complied with. If the data sheet is not available, please order or download it from our homepage. (http://www.bdsensors.com/products/download/datasheets)

⚠ WARNING! – Danger through improper usage!

1.6 Package contents

Please verify that all listed parts are undamaged included in the delivery and check for consistency specified in your order:

- electronic pressure switch, series DS 4XX
- for mechanical pressure ports DIN 3852: o-ring (pre-assembled)
- sheet of unit labels
- mounting instructions

2. Product identification

The device can be identified by its manufacturing label. It provides the most important data. By the ordering code the product can be clearly identified. The programme version of the firmware, (e. g. P07) will appear for about 1 second in the display after starting up the device. Please hold it ready for inquiry calls.

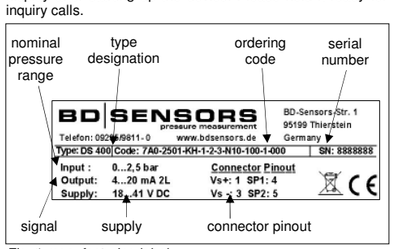


Fig. 1 manufacturing label

! The manufacturing label must not be removed from the device!

3. Mechanical installation

3.1 Mounting and safety instructions

⚠ WARNING! Install the device only when depressurized and currentless!

⚠ WARNING! This device may only be installed by qualified technical personnel who has read and understood the operating manual!

⚠ DANGER! Explosion hazard, with devices for oxygen applications, when used improperly. To ensure a usage without danger, the following points must be adhered to:

- Make sure, your device has been ordered and delivered as a special version for oxygen applications. You can check the manufacturing label (see figure 1). If the ordering code ends with "007", then the device is suitable for oxygen applications.
- At time of delivery the device is packed into a plastic bag in order to prevent it from impurity. Please observe the indication label "Device for oxygen, unpack only directly before assembling". Also, avoid any skin contacts during unpacking and assembly, in order to prevent greasy residues on the device.
- During installation, the respective explosion protection regulations have to be met. Check, if ATEX-approval is necessary for this type (oxygen) device. (the delivered device has no ATEX-approval)
- Note the entire design requirements meet the standard demand of BAM (DIN 19247).
- For devices with oxygen capability up to 50 bar, o-rings V747-75 with BAM-approval are being used. The max. capabilities allowed, are 40 bar/130° C and 50 bar/100° C.
- For devices with oxygen capability over 50 bar, o-rings FKM 90 are being used. These have been tested up to 95° C and 215 bar in the scientific coal research institute in Ostrava – CZ.

! Handle this high-sensitive electronic precision measuring device with care, both in packed and unpacked condition!

! There are no modifications/changes to be made on the device.

! Do not throw the package/device!

! To avoid damaging the diaphragm, remove packaging and protective cap only directly before starting up the device. A delivered protective cap must be stored!

! Place the protective cap on the pressure port again immediately after disassembling.

! Handle the unprotected diaphragm very carefully - it is very sensitive and may be easily damaged.

! Do not use any force when installing the device to prevent damage of the device and the plant!

! For installations outdoor and in damp areas following these instructions:

- To prevent moisture admission in the plug the device should be installed electrically after mounting, at once. Otherwise a moisture admission has to be blocked e.g. by using a suitable protection cap. (The ingress protection in the data sheet is valid for the connected device.)
- Choose an assembly position, which allows the flow-off of splashed water and condensation. Avoid permanent fluid at sealing surfaces!
- When using a cable gland device, turn the outgoing cable downwards. If the cable has to be turned upwards, then point it downward so the moisture can drain.
- Install the device in such a way that it is protected from direct solar irradiation. Direct solar irradiation can lead to the permissible operating temperature being overstepped in the worst case. By this the operability of the device can be affected or damaged. If the internal pressure increases due to solar irradiation, measurement errors may be caused.

! For devices with gauge reference in the housing (small hole next to the electrical connection), install the device in such a way, that the gauge reference is protected from dirt and moisture. Should the device be exposed to fluid admission, the functionality will be blocked by the gauge reference. An exact measurement in this condition is not possible. Furthermore this can lead to damages on the device.

☞ Take note that no assembly stress occurs at the pressure port, since this may cause a shifting of the characteristic curve. This is especially important for very small pressure ranges as well as for devices with a pressure port made of plastic.

☞ In hydraulic systems, position the device in such a way that the pressure port points upward (ventilation).

☞ Provide a cooling line when using the device in steam piping.

☞ If installing the device outdoor and there is any danger of lightning or overpressure we suggest putting a overpressure protection unit between the supply/switch cabinet and the device to prevent damage.

3.2 General installation steps

- Carefully remove the pressure measuring device from the package and dispose of the package properly.
- Go ahead as detailed in the specific instructions below.

3.3 Installation steps for DIN 3852

- Check to ensure the proper groove fitting of the o-ring and additionally to ensure no damage to the o-ring.
- Ensure that the sealing surface of the taking part is perfectly smooth and clean.
- Screw the device into the corresponding thread by hand.
- If you have a device with a knurled ring, the transmitter has to be screwed in by hand only.
- Devices with a spanner flat have to be fully tightened with an open-end wrench (wrench size of steel: G1/4": approx. 5 Nm; G1/2": approx. 10 Nm; G3/4": approx. 15 Nm; G1": approx. 20 Nm; wrench size of plastic: max. 3 Nm).

3.4 Installation steps for EN 837

- Use a suitable seal, corresponding to the medium and the pressure input (e. g. a cooper gasket).
- Ensure that the sealing surface of the taking part is perfectly smooth and clean.
- Screw the device into the corresponding thread by hand.
- Tighten it with a wrench (for G1/4": approx. 20 Nm; for G1/2": approx. 50 Nm).

3.5 Installation steps for NPT

- Use a suitable seal, corresponding to the medium and the pressure input (e. g. a PTFE-strip).
- Screw the device into the corresponding thread by hand.
- Tighten it with a wrench (for 1/4" NPT: approx. 30 Nm; for 1/2" NPT: approx. 70 Nm).

3.6 Installation steps for dairy pipe

- Check to ensure that the O-ring fits properly into the intended groove in the mounting part.
- Centre the dairy pipe connection in the counterpart.
- Screw the cup nut onto the mounting part.
- Then tighten it with a hook wrench.

3.7 Installation steps for Clamp and Varivent®

- Use a suitable seal corresponding to the medium and the pressure input.
- Put the seal onto the corresponding mounting part.
- Centre the Clamp or Varivent® connection on the fitting counterpart with seal.
- Then fit the device with a suitable fastening element (e. g. semi-ring or retractable ring clamp) according to the supplier's instructions.

3.8 Positioning of the display module

The display and operating module is continuously rotatable so that clear readability is guaranteed even in unusual installation positions. To change the position, go ahead as follows:

- Screw off the metal cap by hand.
- Turn the display and operating module carefully into the desired position by hand. The module is equipped with a rotational limiter.
- Before screwing on the cap again, the o-ring and sealing surfaces of the housing have to be checked for damage and if necessary have to be changed!
- Afterwards screw the metal cap on by hand and make sure that the housing is firmly locked again.

! Pay attention that no moisture can enter the device. Moreover, the seals and the sealing surfaces should not get dirty, as this may cause a reduction of the degree of protection depending on the case of application or place of installation. This can lead to a breakdown of the devices or to irreparable damages on the device.

4. Electrical Installation

⚠ WARNING! Install the device only when depressurized and currentless!

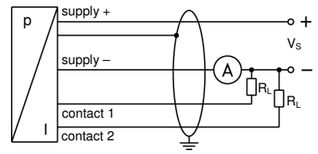
Establish the electrical connection of the device according to the technical data shown on the manufacturing label, the pin configuration and the respective wiring diagram shown below.

Pin configuration:

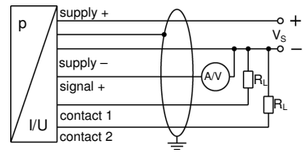
Electrical connections	M12x1, metal (5-pin)	cable colours (DIN 47100)
Supply +	1	wh (white)
Supply –	3	bn (brown)
3-wire: Signal +	2	gn (green)
Contact 1	4	gr (grey)
Contact 2	5	pn (pink)
Shield	plug housing / pressure port	gn/ye (green/yellow)

Wiring diagrams:

2-wire-system (current)



3-wire-system (current/voltage)



! For the installation of a device with cable outlet following bending radiuses have to be complied with:

cable without ventilation tube:
static installation : 5-fold cable diameter
dynamic application: 10-fold cable diameter

cable with ventilation tube:
static installation : 10-fold cable diameter
dynamic application: 20-fold cable diameter

! Prevent the damage or removal of the PTFE filter which is fixed over the end of the air tube on devices with cable outlet and integrated air tube.

☞ For the electrical connection a shielded and twisted multicore cable is recommended.

5. Initial start-up

⚠ WARNING! Before start-up, the user has to check for proper installation and for any visible defects.

⚠ WARNING! The device can be started and operated by authorized personnel only, who have read and understood the operating manual!

⚠ WARNING! The device has to be used within the technical specifications, only (check the technical data in the data sheet)!

6. Operation

6.1 Operating and display elements

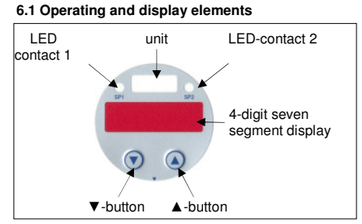


Fig. 2 touchpad for device with two contacts

The device has, according to the order max. two LEDs which are allocated to the resp. contacts. The LEDs will light up when the respective set point has been reached and the contact is active. The display of the measured value as well as the configuration of the individual parameters occurs menu-driven via the seven-segment display.

6.2 Configuration

The menu system is a closed system allowing you to scroll both forward and backward through the individual set-up menus to navigate to the desired setting item. All settings are permanently stored in an EEPROM and therefore available again even after disconnecting from the supply voltage. The structure of the menu system is the same for all types of devices, regardless of the number of contacts. However, they only differ by the number of menus. Following figure and the menu list shows all possible menus. On devices with 3-wire output 4 ... 20 mA and 0 ... 20 mA, the menus ZP and EP have special functions. The menu DP is not applied, as the decimal point is already factory set during production.

☞ Please follow the manual meticulously and remember that changes of the adjustable parameters (switch-on point, switch-off point, etc.) become only effective after pushing both buttons simultaneously and leaving the menu item.

! Pay attention that no moisture can enter the device during configuration. Moreover, the seals and the sealing surfaces should not get dirty, as this may cause a reduction of the degree of protection depending on the case of application or place of installation. This can lead to a breakdown of the device or to irreparable damages on the device. Right after configuration, the metal cap has to be screwed on again.

6.3 Password system

To avoid a configuration by unauthorized persons, the possibility is given to lock the device by an access protection. More information is given in menu 1 of the menu list.

6.4 Configuration example of the analogue output for 3-wire devices

By the menus ZP and EP, the analogue output for 3-wire devices (4...20 mA and 0...20 mA) can be configured. In the following, the function of these menus shall be made clear by an example: assuming you have a pressure switch with a nominal pressure range 0 ... 400 bar with an analogue signal of 4...20 mA / 3-wire. By factory the following performance is set:

0 bar = 4.00 mA 200 bar = 12.00 mA 400 bar = 20 mA

If you change the value in the menu ZP from 0 to 20 and the value in the menu EP from 400 to 300, the following performance will appear:

20 bar = 4.00 mA 160 bar = 12.00 mA 300 bar = 20 mA

☞ The values of ZP and EP are adjustable up to 1:6 of the nominal pressure range.

6.5. Description of hysteresis and compare mode

To invert the respective modes, you have to exchange the values for the switch-on and switch-off points.

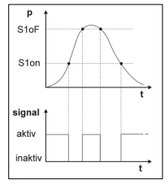


Fig. 3 compare mode

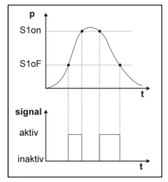


Fig. 4 compare mode inverted

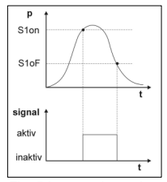


Fig. 5 hysteresis mode

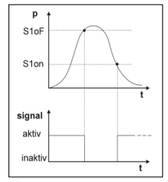
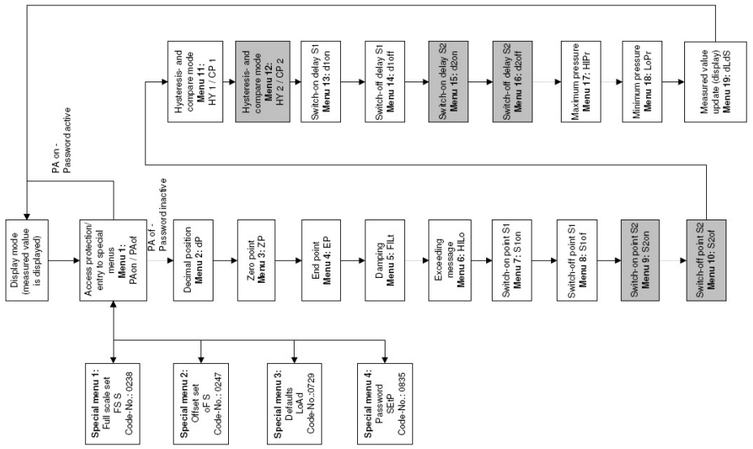


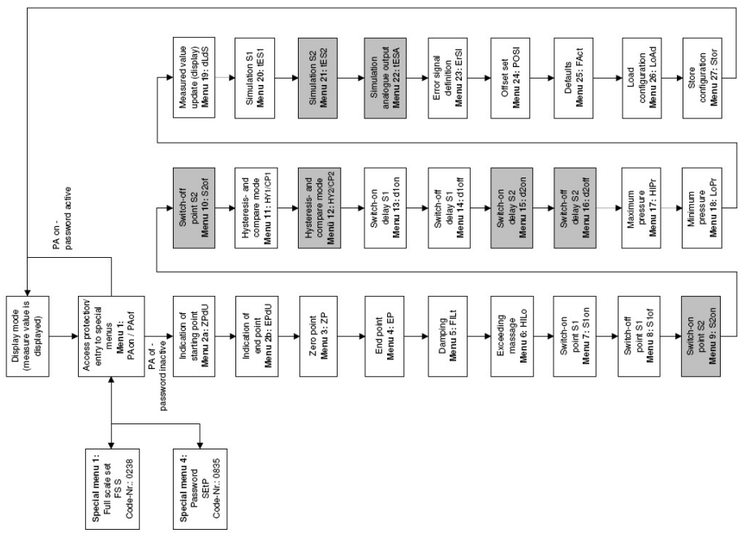
Fig. 6 hysteresis mode inverted

6.6. Structure of the menu system

2-wire-version P07


Hysteresis- and compare mode Menu 11: HY 1 / CP 1
Hysteresis- and compare mode Menu 12: HY 2 / CP 2
Switch-on delay S1 Menu 13: d1on
Switch-off delay S1 Menu 14: d1oF
Switch-on delay S2 Menu 15: d2on
Switch-off delay S2 Menu 16: d2oF
Maximum pressure Menu 17: HPr
Minimum pressure Menu 18: LoPr
Measured value update (display) Menu 19: dLdS
PA on - Password active
Display mode (measured value is displayed)
Access protection/ entry to special menus Menu 1: PAon / PAof
PA of - Password inactive
Decimal position Menu 2: dP
Zero point Menu 3: ZP
End point Menu 4: EP
Damping Menu 5: FiLt
Exceeding message Menu 6: HiLo
Switch-on point S1 Menu 7: S1on
Switch-off point S1 Menu 8: S1oF
Switch-on point S2 Menu 9: S2on
Switch-off point S2 Menu 10: S2oF
Special menu 1: Full scale set FS S Code-No.: 0238
Special menu 2: Offset set oF S Code-No.: 0247
Special menu 3: Defaults LoAd Code-No.:0729
Special menu 4: Password SEtP Code-No.: 0835

3-wire-version P07


Measured value update (display) Menu 19: dLdS
Simulation S1 Menu 20: tES1
Simulation S2 Menu 21: tES2
Simulation analogue output Menu 22: tESA
Error signal definition Menu 23: ErSi
Offset set Menu 24: POSI
Defaults Menu 25: FAct
Load configuration Menu 26: LoAd
Store configuration Menu 27: Stor
PA on - password active
Display mode (measured value is displayed)
Access protection/ entry to special menus Menu 1: PAon / PAof
PA of - password inactive
Indication of end point Menu 2a: ZPdU
Indication of end point Menu 2b: EPdU
Zero point Menu 3: ZP
End point Menu 4: EP
Damping Menu 5: FiLt
Exceeding massage Menu 6: HiLo
Switch-on point S1 Menu 7: S1on
Switch-off point S1 Menu 8: S1oF
Switch-on point S2 Menu 9: S2on
Switch-off point S2 Menu 10: S2oF
Hysteresis- and compare mode Menu 11: HY/CP1
Hysteresis- and compare mode Menu 12: HY/CP2
Switch-on delay S1 Menu 13: d1on
Switch-off delay S1 Menu 14: d1oF
Switch-on delay S2 Menu 15: d2on
Switch-off delay S2 Menu 16: d2oF
Maximum pressure Menu 17: HPr
Minimum pressure Menu 18: LoPr
Special menu 1: Full scale set FS S Code-Nr.: 0238
Special menu 4: Password SEtP Code-Nr.: 0835

6.7 Menu list

- ▲-button: move in the menu system (forward) or increase the displayed value; it will also lead you to the operating mode (beginning with menu 1)
- ▼-button: move in the menu system (backward) or decrease the displayed value; it will also lead you to the operating mode (beginning with the last menu)
- both buttons simultaneously: confirm the menu items and set values

☞ to increase the counting speed, when setting the values: keeping the respective button pushed for more than 5 seconds

Execution of configuration:

- set the desired menu item by pushing the ▲- or ▼-button
- activate the set menu item by pushing both buttons simultaneously
- set the desired value or select one of the offered settings by using the ▲- or ▼-button
- store the set value / selected setting and exit the menu by pushing both buttons simultaneously

PAon PAoF	**menu 1 – access protection** PAon ➔ password **active** ➔ to deactivate: set password PAof ➔ password **inactive** ➔ to activate: set password ☞ default setting for the password is "0005"; modification of the password is described in special menu 4
dP	**menu 2 – set decimal point position (only 2-wire-system)** ☞ for devices with 3-wire output 4 ... 20 mA and 0 ... 20 mA the decimal point was already set during production
2PdU	**menu 2a – indication of the starting point, which was defined with the order (only 3-wire-system)** no configuration is possible
EPdU	**menu 2b – indication of the end point, which was defined with the order (only 3-wire-system)** no configuration is possible
ZP EP	**menus 3 and 4 – set zero point / end point** the device has been configured correctly before delivery, so a later setting of a 2-wire device is only necessary, if a differing displayed value is desired (e. g. 0 ... 100 %) ☞ For devices with 3-wire output 4 ... 20 mA and 0 ... 20 mA this menu has a different meaning: The configuration of the zero point causes a changing of the analogue output, whereas the display value remains unchanged. (zero and end point can be configured within the limits of the nominal pressure range, according to the manufacturing label); for more information see "6.4 Configuration example of the analogue output for 3-wire-devices"
FiLt	**menu 5 – set damping** this function allows getting a constant display value although the measuring values may vary considerably; the time constant for a simulated low-pass filter can be set (0.3 up to 30 sec permissible)
HiLo	**menu 6 – exceeding message** set "on" or "off"
S1on	**menus 7and 9 – set switch-on points** set the particular values, for the activation of contact 1 (S1on) or 2 (S2on)
S1oF	**menus 8 and 10 – set switch-off points** set the particular values, for the deactivation of contact 1 (S1oF) or 2 (S2oF)
HY 1 CP 1	**menus 11 and 12 – select hysteresis or compare mode** select the hysteresis mode (HY 1/2) or compare mode (CP 1/2) for the contacts 1 or 2 (no. corresponds to the contact) ☞ compare "6.5. Description of hysteresis and compare mode"
d1on	**menus 13 and 15 – set switch-on delay** set the particular value of the switch-on delay after reaching contact 1 (d1on) or 2 (d2on) (0 up to 100 sec permissible)
d1oF	**menus 14 and 16 – set switch-off delay** set the particular value of the delay after reaching the switch-of point 1 (d1oF) or 2 (d2oF) (0 up to 100 sec permissible)
HPr LoPr	**menus 17 and 18 – maximum / minimum pressure display** view high pressure (HIPr) or low pressure (LoPr) during the measurement process (the value will not remain stored if the power supply is interrupted) ☞ to erase: push both buttons again within one second
dLdS	**menu 19 – measured value update (display)** set the length of the update cycles for the display (0.0 up to 10 sec permissible)
tES1	**menus 20 and 21 – simulate contacts (only 3-wire-system)** with the ▲- or ▼-button the contacts 1 (tES1) or 2 (tES2) can be activated or deactivated
tESA	**menu 22 – simulate analogue output (only 3-wire-system)** select one of the following settings: "oi 4" (4 mA or 2 V), "oi12" (12 mA or 6 V) and "oi20" (20 mA or 10 V)
ErSi	**menu 23 – error signal definition (only 3-wire-system)** set the desired error signal (this is given out in case of a defect); permissible settings are "OFF" (no error signal output), "C 0" (0 mA or 0 V), "C LO" (3.5 mA or 1.75 V) and "C HI" (23 mA or 11.5 V) ☞ an output of the error signal is only given when menu 6 is set on "on"
POSI	**menu 24 – offset compensation / position correction (only 3-wire-system)** confirm menu item "P0SI"; if offset ≠ ambient pressure it is necessary to place the device under pressure (pressure reference has to corresponding to the zero point of the pressure measuring range); push both buttons to store the signal being emitted from the pressure switch as offset; in the display the set zero point will appear although the sensor signal in the offset is displaced ☞ a position correction is necessary, if the installation position differs from the calibration position (otherwise this can cause a little deviation of the signal, which gives a wrong value indication) ☞ the analogue output signal (for devices with analogue output) is not affected by this change; when displacing the offset, the full scale will also be displaced
FAct	**menu 25 – load defaults (only 3-wire-system)** to load the defaults, push both buttons simultaneously, after confirming the menu item ☞ any changes carried out will be reset (password will be set on "0005")
LoAd	**menu 26 – load configuration (only 3-wire-system)** to load a stored configuration (via menu 39), set the desired number 1 up to 5
Stor	**menu 27 – store configuration (only 3-wire-system)** to store a configuration, set the desired number 1 up to 5
special menus	(to access a special menu, select the menu item "PAof" with the ▲- or ▼-button and confirm it; "1" appears in the display)
FS S	**special menu 1 – full scale compensation** for full scale compensation, which is necessary if the indicated value for full scale differs from the real full scale value in the application (a compensation is only possible with a respective reference source, if the deviation of the measured value is within defined limits); set "0238"; confirm with both buttons; "FS S" will appear in the display; now it is necessary to place the device under pressure (the pressure must correspond to the end point of the pressure measuring range); push both buttons, to store the signal being emitted from the pressure switch as full scale; in the display the set end point will appear although the full scale sensor signal is displaced. ☞ the analogue output signal (for devices with analogue output) is not affected by this change
oF S	**special menu 2 – offset compensation / position correction (only 2-wire-system)** set "0247"; the menu description is identical with menu "P0SI" (menu 24) for 3-wire-devices
LoAd	**special menu 3 – load defaults (only 2-wire-system)** set "0729"; the menu description is identical with menu "FAct" (menu 25) for 3-wire-devices
SEtP	**special menu 4 – set password** set "0835"; confirm with both buttons; "SEtP" appears in the display; set the password using the ▲- or ▼-button (0 ... 9999 are permissible, the code numbers 0238, 0247, 0729, 0835 are exempt); confirm the password by pushing both buttons simultaneously

7. Placing out of service

⚠ WARNING! When dismantling the device, it must always be done in the depressurized and currentless condition! Check also if the medium has to be drained off before dismantling!

⚠ WARNING! Depending on the medium, it may cause danger for the user. Comply therefore with adequate precautions for purification.

8. Maintenance

In principle, this device is maintenance-free. If desired, the housing of the device can be cleaned when switched of using a damp cloth and non-aggressive cleaning solutions.

Depending on the measuring medium, however, the diaphragm may be polluted or coated with deposit. If the medium is known for such tendencies, the user has to set appropriate cleaning intervals. After placing the device out of service correctly, the diaphragm can usually be cleaned carefully with a non-aggressive cleaning solution and a soft brush or sponge. If the diaphragm is calcified, it is recommended to send the device to BD SENSORS for decalcification. Please read therefore the chapter "Service/Repair" below.

! An incorrect cleaning can cause irreparable damages on diaphragm. Never use spiky objects or pressured air for cleaning the diaphragm.

9. Service / Repair

9.1 Recalibration

During the life-time of the device, the value of offset and span may shift. As a consequence, a deviating signal value in reference to the nominal pressure range starting point or end point may be transmitted. If one of these two phenomena occurs after prolonged use, a recalibration is recommended to ensure furthermore high accuracy.

9.2 Return

Before every return of your device, whether for recalibration, decalcification, modifications or repair, it is necessary to contact us to ensure a fast handling of your request. Please inform us by sending an email to: return@bdsensors.de. Include the number of devices sent and request a RMA. Then clean the device and pack it shatterproof before send it to BD SENSORS indicating the RMA.

10. Disposal

The device must be disposed according to the European Directives 2002/96/EG and 2003/108/EG (on waste electrical and electronic equipment). Waste of electrical and electronic equipment may not be disposed by domestic refuse!

⚠ WARNING! Depending on the measuring medium, deposit on the device may cause danger for the user and the environment. Comply with adequate precautions for purification and dispose of it properly.

11. Warranty conditions

The warranty conditions are subject to the legal warranty period of 24 months from the date of delivery. In case of improper use, modifications of or damages to the device, we do not accept warranty claims. Damaged diaphragms will also not be accepted. Furthermore, defects due to normal wear are not subject to warranty services.

12. Declaration of conformity / CE

The delivered device fulfils all legal requirements. The applied directives, harmonised standards and documents are listed in the EC declaration of conformity, which is available online at: http://www.bdsensors.com/products/download/certificates.
Additionally, the operational safety is confirmed by the CE sign on the manufacturing label.